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Effect of temperature on thrips breeding in onion bulbs: laboratory experiments

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1 Executive summary

These experiments are a continuation of last year's research into the ability of onion thrips to breed on onions. This years research focuses on the effect of high temperature on the fecundity and mortality of onion thrips (*Thrips tabaci*) in onion bulbs.

Experiments were conducted in the laboratory to determine the rate of reproduction of onion thrips (*Thrips tabaci*) in the bulbs of Pukekohe Long Keeper (PLK) onions grown at both Pukekohe and Matamata and in red onions and leeks. Temperatures were maintained between 20 and 45°C.

Windows were cut in the outer dead skins of the onions to provide thrips with easy access to the onion bulb tissue. The onions and leek segments were infested with 10 adult thrips and the number of progeny recorded after seven to eight days.

The reproductive rate of thrips at temperatures between 25 and 40°C was highest on leeks, intermediate on red onions, and lowest on brown onions. There was no apparent difference in the rate of reproduction of thrips on PLK onion bulbs grown at Pukekohe or Matamata.

The maximum rate of reproduction occurred at 30°C in brown onions, red onions and leeks. Tests on brown onions in which ample airflow was provided showed that the rate of reproduction and survival of the adult females on brown onions declined at temperatures above 30°C.

The upper thermal limit for reproduction and survival of onion thrips in PLK onion bulbs was between 37.5 and 40°C over a 7 day period.

A new bioassay to measure the reproductive capacity of thrips on onion cultivars has been developed based on the numbers of eggs laid by thrips in discs cut from onion scales.

1.1 Conclusions

- This report confirms that PLK onion bulbs are not a favoured host by onion thrips, and rates of onion thrips reproduction are higher on red onions and leeks at temperatures between 20 and 40°C. While the rate of reproduction is lower on PLK onion bulbs, this food substrate did not appear to affect the longevity of adult thrips.
- The survival rates of thrips on leeks, red onions and PLK onions were similar.
- There was no difference in the reproductive capacity of onion thrips on PLK onions grown in Pukekohe or Matamata.

This research showed that PLK onion bulbs are not a favoured host by onion thrips

- Onion thrips produced more larvae on the PLK onion bulbs in the 2002 season than they did in the 2001 trials, but it is unclear whether this was due to different qualities of the onions or to a more vigorous colony of thrips.

2 Introduction

In *Crop & Food Report Confidential Report No. 409* (Onion thrips breeding and damage to onion bulbs: laboratory studies), it was established that the reproductive rate of thrips in Pukekohe Long Keeper (PLK) onion bulbs was very low compared with the rate in red onions or leeks at 25°C. This report examines the reproductive capacity of onion thrips on leeks and red onions with that on PLK onions grown at both Pukekohe and Matamata at temperatures between 20 and 45°C. The research also establishes the maximum temperature at which onion thrips reproduce in PLK onion bulbs.

3 Method

3.1 Reproduction and survival of onion thrips on onions and leeks

The ability of onion thrips to reproduce at a range of temperatures was tested on PLK onions grown at Pukekohe (Pukekohe Research Centre) and Matamata (A S Wilcox & Sons Ltd: Line 273), along with red onions from Pukekohe (A S Wilcox & Sons Ltd: Line 244), and leeks purchased from commercial outlets. Fresh onion tissue was exposed by cutting 2 cm^2 windows through the dry skin and the first fleshy scale of brown and red onions. The cuts for the window were only made on three sides so a flap of skin and scale was retained. The tops of the onions were sealed with hot wax to prevent contamination with thrips that may have been in the interior of the onion. Individual onions were placed in plastic jars (130 mm tall, 90 mm diameter). Segments of leeks (2-3 rings, 30 mm long) were also placed in individual jars. Ten adult female thrips from colonies established in January 2002 from onions at Pukekohe and reared on leeks were added to the jars. The tops of the jars were covered with a paper tissue and a lid with a 35 mm hole. Because the leek rings rapidly dried, fresh segments were added three times each week. The jars were kept at a range of temperatures from 20, 25, 30, 35, 37.5, 40, to 45°C in 16 hours light and 8 hours dark. The rate of reproduction at each temperature was tested at least twice with 10 replicates for each temperature in each test. The jars at 20 and 25°C were in temperature controlled rooms. The jars at temperatures above 25°C were in small temperature controlled cabinets. The onions and leeks were examined after seven to eight days and the numbers of larvae produced recorded.

3.2 *Upper thermal development limit of onion thrips in PLK bulbs*

During these trials it became apparent that the temperatures varied within the small temperature controlled cabinets. A second series of trials was set up using only the PLK onions from the Pukekohe Research Centre in which the temperatures experienced by the thrips were closer to the nominal treatment temperatures. The rate of reproduction and survival of onion thrips at 30, 35, 37.5 and 40°C was tested on 2 separate occasions. Each temperature treatment was replicated 10 times for each test. The onions were examined after eight days and the numbers of larvae produced counted.

4 *Results*

4.1 *Reproduction and survival of onion thrips on onions and leeks at temperatures between 20 and 45°C*

The reproductive rate of onion thrips at all temperatures between 20 and 40°C was highest on leeks and lowest on PLK onions (Fig. 1). The rate on red onions was between that of leeks and PLK onions. The largest difference in the rates of reproduction was at 30°C when the mean numbers of larvae per thrips were 6.53 on leeks, 3.44 on red onions, 0.90 on PLK from Matamata, and 1.00 on PLK from Pukekohe.

There was no apparent difference in the rate of reproduction of thrips on the PLK onions from Pukekohe and the PLK onions from Matamata.

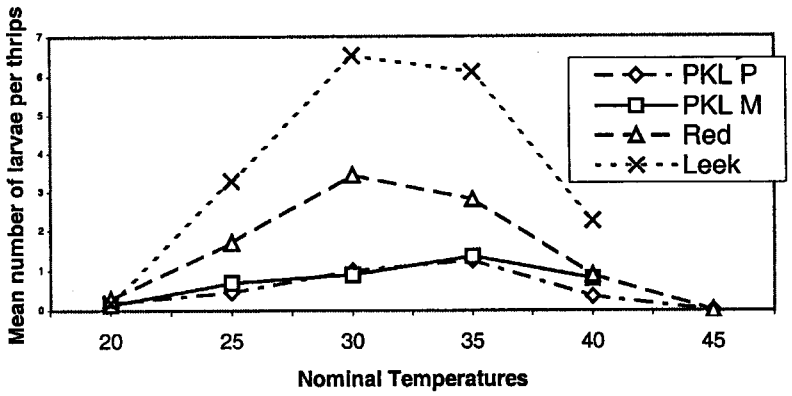

Figure 1: The mean number of larvae produced per thrips after seven days. The temperatures are described as nominal because they differed by up to 5°C, depending on the position of the jars in the temperature cabinet.

Although thrips reproduce more slowly on PLK onions than on red onions or leeks this difference was not reflected in the ability of adult thrips to survive for seven days on these substrates (Fig. 2). At temperatures between 20 and 35°C the survival of the adult female thrips (measured as the percentage of adults surviving) on all substrates varied between 25 and 40%, and declined as temperatures reached 40°C.

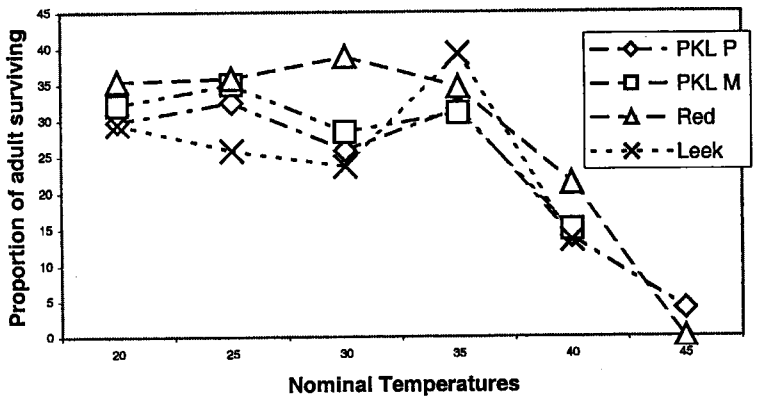

Figure 2: The proportion of adult thrips surviving after seven days. The temperatures are described as nominal because they varied by up to 5°C, depending on the position of the jars in the temperature cabinet.

The temperatures can only be described as nominal because they varied by up to 5°C, depending on the position of the jars within the cabinet. he large numbers of containers in the cabinet meant that airflow was restricted resulting in uneven temperatures.

4.2 *Upper thermal development limit of onion thrips in PLK bulbs*

The upper thermal limit at which thrips ceased to develop in PLK onion bulbs was between 37.5 and 40°C (Table 1). Reproduction and survival of onion thrips in PLK bulbs was greatest at 30°C.

Table 1: The rate of reproduction and survival of onion thrips in PKL bulbs at temperatures between 30 and 40°C.

	30°C	35°C	37.5°C	40°C
Mean number of larvae/thrips	1.5	0.57	0.25	0
Proportion of thrips surviving for 7 days	42.5	23.0	16.5	0

4.3 Comparison of results for the previous season

In the previous 2000-2001 season, similar tests were undertaken to examine the rate of thrips reproduction on leeks and red onions, but tests were performed only at 25°C. Comparing these results with data from the current season at 25°C confirms that the rate of reproduction is slower on PLK onion bulbs than on red onions or leeks. However, the range in rates of reproduction amongst the substrates was less dramatic this season than last (Table 2). Last year the mean number of larvae/thrips ranged from 0.07 to 15.4 across the three substrates, while this season the range was only 0.46 to 3.29. The rate of reproduction of onion thrips on PLK bulbs in 2002 was larger by a factor of over 7 compared to the 2001 season. Whether this is due to differences in the onion bulbs in the wetter 2002 season, or to differences in vigour in a new onion thrips colony is unknown. The rate of reproduction also increased in red onion bulbs in the current trial, while the rate of reproduction on leeks was much lower than in the previous season.

Table 2: Mean number of larvae produced by onion thrips on leek, red onion and PLK onions at 25°C in laboratory tests during 2001 and 2002.

	Mean larvae/thrips 2001	Mean larvae/thrips 2002
PLK onions	0.07	0.46
Red onions	0.88	1.71
Leeks	15.4	3.29

4.4 Related FfRST-funded research in 2001-2002

The bioassay to assess the reproductive potential of onion thrips in leeks and onion cultivars has been modified by observing the fecundity of individual thrips on 5 mm discs of the test substrate. This method enables the numbers of eggs laid within a single bulb to be measured several times and the remaining bulb to be stored for chemical analysis. This method will also allow the reproductive capacity of onion thrips on onion leaves to be compared with that in the bulb.

When developing this bioassay we found that:

- there was no consistent difference in the number of eggs laid by thrips in the white, light green or dark green areas of leek leaves,
- fewer eggs were laid on the outer than inner sheaths of leeks,
- the mean number of eggs produced by a thrips each day was 4.95 on leeks, 0.29 on red onion bulbs, and 0.18 on PLK onion bulbs three days after placing the onion thrips on the selected food.

5 Conclusions

This report confirms that PLK onion bulbs are not a favoured host by onion thrips, and rates of onion thrips reproduction are higher on red onions and leeks at temperatures between 20 and 40°C. While the rate of reproduction is lower on PLK onion bulbs, this food substrate did not appear to affect the longevity of adult thrips. The survival rates of thrips on leeks, red onions and PLK onions were similar. There was no difference in the reproductive capacity of onion thrips on PLK onions grown in Pukekohe or Matamata. Onion thrips produced more larvae on the PLK onion bulbs in the 2002 season than they did in the 2001 trials, but it is unclear whether this was due to different qualities of the onions or to a more vigorous colony of thrips.

A new bioassay has been developed based on the fecundity of individual thrips on discs of scale from the onion bulb. This bioassay will be used to assess the ability of thrips to produce eggs on a range of onion cultivars; reproductive rates will reflect differences in the chemical composition of bulbs.

6 Acknowledgements

We wish to thank Anna Ravelich of A S Wilcox & Sons Ltd for supplying the red onions and PLK onions from Matamata, Barry Childes for managing and spraying the PLK onions grown at the Pukekohe Research Centre, and Kevin May for technical assistance.